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ABSTRACT

This report examines the relationship between school leadership and effective utilization of technology. As an aid to identifying a wide variety of technology policy decisions, a taxonomy of educational technology leadership decisions was constructed. Decisions that pertain primarily to the infrastructure are distinguished from those that deal primarily with instructional processes, although many decisions apply to both. The taxonomy divides decisions into six functions: strategic planning, goal setting, vision and vision sharing; budgeting and spending; organizational structure and processes; curriculum; program evaluation and impact assessment; and external relations and ethical issues. Before analyzing each of these six types of decisions, the distinction between the administrator and the teacher as leaders is considered. This discussion examines decision making mostly from the standpoint of the administrators, including principals, technology coordinators, and others in administrative roles. The national probability sample of schools consisted of 898 public, private, and parochial schools. Survey findings in this report are organized in three parts. The first section gives percentages for all United States schools that have adopted technology-related policies and what proportion of schools possess different technology leadership characteristics. Next, technology leadership is broken down by school demographic factors, examining which types of schools have more or less technology leadership. Finally, one aspect of the technology leadership model (that shows technology leadership to be influenced by background factors such as type of school and by infrastructure factors such as amount spent on technology) is tested, specifically, the relationship between technology leadership and technology integration. (Contains 24 references.) (AEF)

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INTRODUCTION

Popular and traditional views of leadership emphasize a leader's charisma and personal strength, but more rigorous models of leadership focus upon interrelationships among distributed participants (Neuman and Simmons 2000; Schultz, 2000), a leader's ability to cope with complex change (Fullan & Stiegelbauer 1991), and whether an organization has established a culture of a continuous learning (Senge 1990). Decision-making in schools concerning electronic information and communication technologies is a particularly appropriate setting for analyzing how these three forces play out because change is so basic to managing this new technology. In this analysis we apply this organizational perspective to technology leadership, rather than viewing it either in terms of personality or as a set of skills (cf. Jewell 1998/1999; Kearsley and Lynch, 1992). Technology leaders—teachers and administrators—who view their school as a learning organization will, not only set goals and coordinate activities, but also will design and participate in learning processes themselves (cf. Louis 1994). In a school with distributed leadership everyone applies their competencies to improving student learning (Neuman and Simmons 2000). Consequently it is more appropriate to view technology leadership as an attribute of schools rather than individuals. This is the perspective taken in this report as we examine the relationship between school leadership and effective utilization of technology.

As an aid to identifying a wide variety of technology policy decisions, we have constructed the taxonomy of educational technology leadership decisions shown in Figure 1. Decisions that pertain primarily to the infrastructure are distinguished from those that deal primarily with instructional processes, although many decisions apply to both. The taxonomy divides decisions into six functions: strategic planning and goal setting, budgeting and spending, organization, curriculum, evaluation, and external relations.

Before analyzing each of these six types of decisions further, we consider the distinction between the administrator and the teacher as leaders. Mehlinger (1996) claims that unlike other educational innovations, successful technology use is driven by teachers rather than outside experts. However, using data from a 1989 national survey, Becker (1993) found evidence for both "top-down" and "bottom-up" effective technology decision-making in American schools. That is, both teachers and at other times, administrators initiated technology innovation. From the point of view of a learning organization, the most important thing is that both groups share vision and work together supportively. While teachers may be involved in making many or all of the technology decisions, in the following discussion we examine decision-making mostly from the standpoint of the administrators including principals, technology coordinators, and others in administrative roles. Each of the six types of leadership functions or decisions will be discussed in turn.

FIGURE 1: TAXONOMY OF EDUCATIONAL TECHNOLOGY LEADERSHIP DECISIONS WITH ILLUSTRATIVE POLICY DECISIONS OR ACTIONS

	Technology Infrastructure	Instructional Practice Using Technology
Strategic Plans, Goal-setting, Vision and Vision Sharing	• Priorities for different types of hardware and software now and in the near future. • Policy for equal access to technology.	• Planning for ensuring student learning of 21st century skills.
Budgeting and Spending	• Equipment renewal plan. • Grant-writing and fund raising [6]. • Adequate technology budget [2].	• Substantial share of the budget for support. • Varieties of software acquired as needed. • District funding support [5].
Organizational structure and processes	• Principal attentive to technology issues [3]. • Staff use of e-mail and other IT for personal and professional work [4]. • Technology Committee [1].	• Rewarding and encouraging staff. • Staff for instructional support services. • Staff technology professional development program [7].
Curriculum	• Accommodation of needs of diverse groups including at-risk students of all types.	• Content standards for infusion of technology. • Media literacy opportunities for all.
Program Evaluation and Impact Assessment	• Periodic measuring of resource utilization. • Formative evaluations of implementations. • Monitor digital divide.	• Regular monitoring of student learning indicators. • Evaluation of instructional practices.
External Relations and Ethical Issues	• Build links with parents and community, e.g., home access to school server. • Policy on filtering software.	• Program for instructional content on Web. • Intellectual property (e.g., AUP) policy in place [8].

Note: Numbers in square brackets refer to eight indicators listed in a later section.

Strategic Planning and Goal-Setting

In addition to setting goals and policies related to technology, many have pointed to "vision" as essential to technology programs. It is also claimed that shared vision is critical to managing information technology in a school setting (Costello 1997; Hoffman 1996). From case studies of two high schools, Dexter (1999) concluded that successful technology implementation depended upon shared goals across various organizational levels. A recent study in Hong Kong by Nancy Law and Associates (1999) found that leadership, especially at the school level, made a big difference in terms of pedagogical improvements in teaching as well as student learning. They concluded that a very important aspect of school leadership is "whether the school has established explicit technology policy goals and specific implementation plans for the current school year and beyond."

Not only do priorities have to be determined for different technology acquisitions but they also need to be identified for instructional goals and desired learning outcomes. Getting policies aligned with these goals and priorities is important. For instance, a stated policy that the school is committed to equal access to technology could result in reduction of access discrimination. A more potent policy would specify details of different types of access and specifically mention the digital divide with respect to income, race, gender, ability, and disability.

Budgeting and Spending

Many technology decisions have to do with budgeting and spending on equipment, networks, software, and support services of all types. Some schools do not have discretionary control over their own technology budget, which may put them at a disadvantage. A Pelavin Research Institute report states that educational technology is unique in that it is not solely a labor, capital or recurring material expense, but rather a hybrid of these (Pelavin 1997). They argue that school technology should be in a separate budget category because of unusually high start-up costs and on-going requirements for professional development. Not only does technology leadership consist of making budgeting and spending decisions, but it almost certainly means fund raising as well. Sometimes the only way to support the costs of technology innovation is through external funding, which implies planning and writing grant proposals.

Organization

Numerous organizational structures have been designed for dealing with technology functions within schools. One of the most common ones in smaller schools is the creation of a single position of technology coordinator (Strudler 1995-96). Often the technology support tasks are spread across several positions. Irrespective of the formal structure, it is important that the administrative leadership reward and encourage staff for their participation in technology-supported projects. In addition, unless the top administrators in a school use the technology themselves, e.g., use email for communication with a variety of groups, other staff will be less likely to utilized the technology (Ritchie, 1996). A formal technology committee, with representation from teachers, administrators, parents, and students, can be very effective. Czarnomski (1996) and VanSciver (1994) propose that the technology committee develop a mission statement for technology use, identify technology needs, oversee the technology budget, and plan staff development and training around technology. A technology committee also may help to mobilize broad support for the technology program (Musco, 1995).

Curriculum

Decisions need to be made about when and how students will learn new media literacy (technology-related skills) and when and how technology-supported activities will be used in learning other subjects (Murphy and Gunter 1997; Thomas & Knezek, 1991). Standards may be defined that specifically define technology skills for students to be able to do. Standards of good teaching practices may define useful approaches to improving teaching with the use of technology. The instructional program must also set policies on how to accommodate the needs of diverse groups including at-risk students of all types.

Evaluation

Effective technology leadership will establish evaluation procedures in order to learn from on-going experiences (Cradler 2000). Regular monitoring of the use of the infrastructure is needed for planning purposes. Periodic measurement of student learning, using a variety of alternative indicators will help to evaluate and refine different approaches to using technology in instruction. These different research functions will make it possible to evaluate the nature of any digital divides in the school.

External Relations

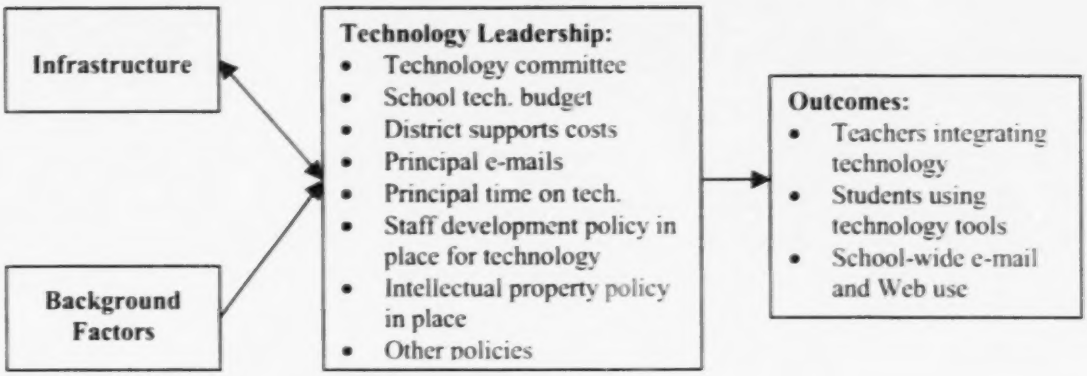
Technology leadership, like leadership generally, must build and maintain links between the school and other groups including parents, community organizations, and support organizations (Bailey 1997). Access for students and parents to school servers and to services through Web sites can facilitate these relationships greatly. In addition, technology leaders need to set policies to deal with ethical matters having to do with use of intellectual property, and access to adult materials using school facilities (cf. Kowch & Walker 1996)

MODELING TECHNOLOGY LEADERSHIP DECISIONS

Each of the different actions or decisions identified as characteristic of technology leadership may potentially have a measurable outcome in terms of the degree of technology integration in the school or the degree to which the school has accomplished other goals. On the basis of the literature and past research we would expect technology leadership to have considerable effect upon the quality of the technology-supported learning environment. In addition, technology leadership is likely to be influenced greatly by background factors such as type of school and by infrastructural factors such as amount spent on technology. Figure 2 depicts this model, showing that infrastructure is likely to be reciprocal, that is, shaped by the technology leadership as well as shaping it. With data from the 1998 survey, Teaching, Learning, and Computing, it is possible to evaluate the extent to which some of several leadership indicators are associated with some desired technology learning outcomes. The model we will test assumes that factors like computer density and Internet bandwidth will be correlated with technology leadership because of a mutually reinforcing relationship. In Figure 2, the boxes for both technology leadership and outcomes contain lists of the indicators from the survey that can be used to apply the model.

The survey findings in this report are organized into three parts. The first section gives percentages for all U.S. schools that have adopted technology-related policies and what proportion of schools possess different technology leadership characteristics. Next we break down technology leadership by school demographic factors, asking which types of schools have more or less technology leadership. Finally, we test one aspect of the model (Figure 2), specifically, the relationship between technology leadership and technology integration.

FIGURE 2: A MODEL OF TECHNOLOGY LEADERSHIP



SAMPLE

In the Spring of 1998, Teaching, Learning, and Computing surveyed principals, technology coordinators and teachers from a national probability sample of schools and from two targeted or purposive samples of schools: (1) high-end technology-using schools and (2) schools that were participating (or where teachers were participating) in one of 52 identified national and regional educational reform programs.

The national probability sample of schools consisted of 898 public, private, and parochial schools selected from a national database of 109,000 schools supplied by the firm of Quality Education Data (QED) of Denver, CO, a marketing information division of Scholastic Corporation. Schools were sampled according to their size (estimated number of full-time teachers of grade 4 and above) and according to how much computer technology they had (using an index incorporating ten different measures of per-capita technology presence). Initial contact letters and roster forms were sent to 898 schools, and after repeated callbacks a total of 655 schools (73%) agreed to participate. From these schools, 488 (75%) of the principals returned completed questionnaires and 467 (71%) of the technology coordinators completed their questionnaires.

The two purposive samples were compiled from a multitude of sources. The "educational reform" purposive sample (470 schools) came from rosters compiled of 52 different educational reform efforts. The high-end technology purposive sample (258 schools) was compiled from three types of sources: publicly available information from school Web sites and books, from one high-end technology education reform program, and from the Quality Education Data database (the schools with the highest technology presence index).

Across the combined probability and purposive samples, there was a 75% response rate at the school roster stage and close to a 70% response rate at the individual respondent level. Thus the entire survey database includes information from 1,150 schools including completed questionnaires from approximately 4,100 teachers, 800 technology coordinators, and 867 principals.

The analysis in this report was based primarily upon information from the principals' survey, although some data items from the technology coordinators' survey were merged into the principal survey data when available. The leadership analysis in this report was done on two

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different bases. The first part of the analysis was done on the probability sample only, which consisted of 488 principal records. Figure 3 and Table 1 give results on this base, less about 14 principals that selectively failed to respond to the items reported. The second part of the analysis was based upon the 488 principal records from the probability file plus an additional 379 from the purpose sample, which constitutes a combined total of 866 principal records. The remaining figures and tables utilized this larger sample base. The first part of the analysis was limited to the probability sample because its goal was to describe or generalize to the entire population of American schools. The second part of the analysis utilized the combined sample because its goal was to show the inter-relationship among variables, which in most instances is generally the same in purposive samples as it is in representative, probability samples.

INDICATORS

Details on the definition and construction of all of the variables used in this report are given in Appendix 1. This section gives additional background on the indicators of school technology leadership and technology outcomes.

Technology Leadership

In developing overall measures of technology leadership, we identified a large number of technology-related activities and attributes that the principal and technology coordinator reported about their school in the TLC survey. Eight dichotomous indicators were selected to best represent the construct of school technology leadership and they are described below. Several potential indicators of technology leadership were dropped because of their relatively low correlations with other indicators. Among the indicators dropped were the amount of technology spending within the previous two years, school technology goals, receipt of technology donations, and the presence of a technology coordinator position.

The School Technology Leadership index constructed was the sum of the following eight organizational policies or actions potentially present at the school. The context of each of these organizational policies or actions within our taxonomy of Leadership Decisions is shown in Figure 1. The policies and actions included in the Technology Leadership Index are numbered one through eight in the figure.

1. *Technology committee* refers to whether or not a school had a computer technology committee.

2. *Technology budget* represents whether or not a school had a budget for technology costs over which the principal or someone else in the school had sole discretionary authority.

3. *Principal days* indicates that the principal spent 5 or more days on technology planning, maintenance or administration during the previous year.

4. *Principal e-mail* means that the principal reported regular use of e-mail to communicate with at least two of the following four groups: teachers, administrative staff, students.

5. *District support* means that the principal indicated that his or her district (or diocese) supported technology costs relatively more than did other districts.

6. *Grants* refers to the fact that the school or district had obtained a special grant in the last three years for an experimental program where at least 5% of the funding was dedicated to computer-related costs.

7. *Staff development policy* indicates whether or not the school had a policy of "periodic staff development regarding technology," according to the principal.

8. *Intellectual property policy* indicates whether or not the school had a policy about "honoring intellectual property rights, e.g., copyrights," according to the principal.

It can be seen from these eight components of school technology leadership that it represents key organizational decisions, policies or actions that have the potential to facilitate improved utilization of information technology throughout the school.

All of these eight attributes both lead to and result from an effective technology program in the school. In other words they are both inputs and outputs, but we consider them to be aspects of technology leadership because their main role is that of 'input' or contributor to the program.

Technology Outcomes

For this investigation several outcome measures were selected to examine the role of technology leadership on educational technology improvement. The three outcome indicators are (technology) *integration, net use*, and *student tool-use*. Each of these indicators is constructed from a number of other indicators. More details are given in Appendix 1.

Integration measures the degree that teachers throughout the school have incoporated computers into their everyday responsibilities. It is based upon the fraction of teachers who are integrating technology into various types of teaching activities, as reported by the technology coordinator.

Net Use is a measure of the extent to which teachers' and others in the school used e-mail and the WWW for a variety of different purposes. The variable is the sum of frequency of teacher and student e-mail and WWW use, not just the type of a school's networking facilities.

Student Tool-Use measures the extent to which students used computers during the school year to do academic work including writing reports, essays, etc.; simulations in science and social studies, spreadsheets, and databases; looking up information on CD-ROMS, the WWW and other computer resources.

These three indicators were not combined, but each used separately in model estimations.

FINDINGS ON POLICIES AND OVERALL TECHNOLOGY LEADERSHIP

First we examine the distributions of the eight technology leadership attributes in the population of American schools using the 1998 TLC probability sample. Figure 3 gives the percent of USA schools with each attribute. Over three fourths of the schools reported having a technology committee. Close to the same percentage indicated that they had an intellectual property policy ad even more reported having a staff development policy in place. About 59% had a principal that spent five or more days on technology matters and about half of the schools had their own technology budget.

As most schools had both policies (staff development and intellectual property) in place, it should be insightful to examine school policies more closely. In fact, the principal survey asked if policies were in place for several other areas as well. The policies ranged from those that were strictly curricular in nature, such as requiring computer competency for students, to those that were fundamentally ethical, such as honoring intellectual property rights. Table 1 lists each of the policies on which we queried the principals to find out if the school had such a policy. We did not ask if the policy was written but only whether or not there was one in place. Also, in Table 1 are the percentages of schools in the United States that reportedly had these policies, based upon the national probability sample of both public and private schools.

FIGURE 3: PERCENT OF USA SCHOOLS WITH EACH LEADERSHIP CHARACTERISTIC
(N=473; PROBABILITY SAMPLE ONLY)

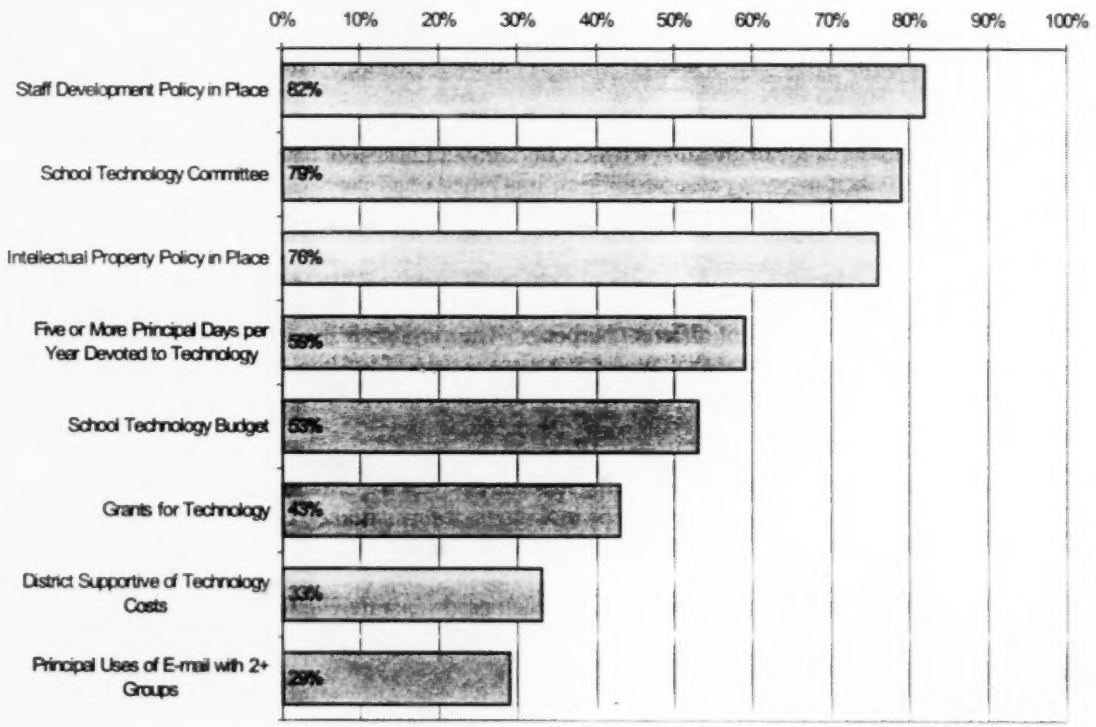

TABLE 1: PERCENT OF SCHOOLS HAVING DIFFERENT TECHNOLOGY POLICIES IN PLACE (N=474)

Policy	Elementary	Middle	High	Total
Prohibition of use of adults-only material	78%	91%	86%	85%
Periodic staff (teacher) technology training	76	83	80	80
Security from unauthorized system access or entry	67	80	88	78
Honoring intellectual property rights, e.g. copyrights	71	79	81	77
Equity in access to technology (within school building)	63	71	64	65
Installation of software not purchased by school	51	63	68	60
Classes or types of students that get to use computers	48	50	36	44
Computer game playing on school computers	29	43	51	41
Student computer-related competency requirement	31	37	47	38
Restriction of software purchases to approved list	30	38	38	35

Source: Teaching, Learning and Computing Survey of K-12 Schools in USA, 1988.

The most pervasive policy listed was the "prohibition of use of adults-only materials," with 84% of all schools claiming to have such a policy. Over three-fourths of all schools also had policies regarding unauthorized system access and on "honoring intellectual property rights, e.g., copyrights." Often these three policy principles are packaged together as a single *acceptable use policy* (*AUP*), which defines an implicit contract between the school and computer system users.

While these policies are statements of ethical expectations, schools establish such standards in part in order to protect themselves from potential legal and political problems as well. The Internet provides access to people, resources, and ideas, many of which are deemed harmful by parents. Establishing these ethical policies provides schools with "the necessary educational context for addressing the many difficult issues that are likely to arise" (Peterson and Hodges 1997: 46).

Another pervasive policy was "periodic staff (teacher) technology training," with 81% reporting such a policy. Other technology curricular policies were not as common, with only 40% having a "student computer-related competency requirement," and 43% having a policy on "classes or types of students that get to use computers." However, 70% reported a policy on "equity of access to technology." And only 43% has a policy on "computer game playing."

The percentages in Table 1 are broken down by three school levels in order to show any differences by grade level. In general, policies were less common in elementary schools than in high schools and middle schools, but the differences were modest. However, while 49% of high schools had a policy on computer game playing, only 32% of elementary schools had one. Significantly, almost as many elementary schools had ethical policies, as did higher-level schools.

The pervasiveness of technology policies is confirmed by the fact that only 2% of the schools had no such policies. Also, more than half (63%) of the K-12 schools had at least 6 of the 10 possible policies in place. Technology policies are organizational mechanisms to attempt to deal with potential problems or to implement the educational goals related to technology. Their pervasiveness reflects the growth of technology in education, and implies that the technology leadership of many schools is functioning.

FINDINGS ON THE ROLE OF SCHOOL DEMOGRAPHICS

In this section we investigate the question of whether or not technology leadership differs across different types of schools. The analysis focuses upon the overall measure of technology leadership, which is based upon eight dichotomous indicators. Technology leadership is broken down into different demographic categories in Table 2 and Figure 4

which shows some of these contrasts between various populations in bar charts. Similar contrasts are given in Figure 5A, 5B, and 5C by level, school SES, and public versus private schools but limited to four of the component indicators. The remaining four indicators tended to have smaller differences and thus were not depicted graphically. The findings are discussed separately for each demographic factor.

Level of School

First we answer the question of whether or not technology leadership differs by school level. As Figure 4 shows, elementary schools are significantly lower than middle and high schools in terms of the overall indicator of technology leadership. In addition, the schools teaching higher grades are more likely than elementary schools to get grants (by 8%), have technology committees (by 10%), have strong district technology support (by 12%), and have principals that are heavy e-mail users (by 14%). On the other leadership indicators elementary schools were essentially the same. The lower average technology leadership levels among elementary schools does not mean that they are less likely to have technology leaders. They are lower partly because the organizational structure of larger and higher-level schools tends to have an advantage on our leadership scale.

Size of School

When comparing schools by the number of students enrolled within each of the three school levels, the larger schools tend to have each of the technology leadership characteristics more often except for district technology support and having a staff development policy in place. Another difference was that principals in smaller schools were more likely than those in larger ones to spend 5 or more days per year on technology issues. Perhaps in larger schools the principal is more likely to delegate technology functions to others. Otherwise, most of our leadership indicators tend to favor larger schools, perhaps because the indicators represent mostly formal policies or procedures that are less necessary in a smaller school where informal solutions are more feasible. For instance, a separate technology committee probably would not be necessary if there were only 5 teachers in a school.

Public/Private

Overall private schools in general are significantly lower than public schools on our measure of technology leadership. This is especially true for getting grants and principal's use of e-mail. While 56% of the public schools had received a grant within the previous three years for which at least 5% went for technology costs, only 15% of private schools had done so. And while 45% of public school principals reported using e-mail with two or more groups, only 8% of those in private schools reported it. It would appear that private schools have some significant disadvantages in this regard. Principals at private schools were less likely to say their district is relatively more supportive of technology costs, which may be due to the fact that some private schools do not have districts. Private and public schools are about equally likely to have a technology committee, to have technology policies in place, to have a technology budget and to have a principal that spends at least 5 days a year on technology. Private schools tend to have a technology leadership disadvantage in that there are fewer sources of technology funding available to them.

Minority%

In general the technology leadership indicators do not differ significantly by the percentage of racial minority students in a school. An exception to this pattern is whether not the school had obtained a grant that covered some (at least 5% of the grant) technology costs. Sixty percent of the schools with 39% or more minority students reported having received such a grant whereas about 40% of the schools with 0 or 1% minority reported one, and in those schools in between, the percentage was about 50%.

Another exception was that in the groups of schools with higher minority levels, the principals were more likely to be using e-mail. Due to Title-I and other funding programs, schools with a high concentration of minority students had a slight advantage (See Table 2).

School SES

As given in Table 1 there is a definite decline of overall technology leadership when the percentage of Title-I eligible students (those meeting official poverty criteria) is greater. That overall pattern was not found when we used average income of households in the school's zip code as the indicator of school SES (socio-economic status), as depicted in Figure 4. For SES (zip code based) the differences were quite small, and the inconsistency of the pattern with that of Title-I eligibility may be due to how the categories were defined. Title-I eligibility was divided into quartiles, whereas SES was basically a dichotomy with a very small third category of only 10% of the cases labeled "Low." Furthermore, schools in the lowest SES level were more likely (60% versus 50%) to report having received a grant covering technology costs. Also, principals in these lowest SES schools were more likely to spend time on technology. Despite these slight disadvantages, the principals in higher SES schools were more likely to use e-mail more extensively. Thus in terms of technology leadership the digital divide is not uniformly wide, perhaps due to compensatory programs. However, it is still possible to conclude that Title-I programs have not fully compensated for the technology leadership disadvantage of schools with a relatively large number Title-I-eligible students.

Sex of Principal

While there is a slight difference in school technology leadership between schools with male versus female principals, it is not statistically significant. The principal's gender does not appear to have any effect on the degree of technology leadership.

Summary of Findings on School Demographics

Larger schools with more formalized procedures have a structural advantage in terms of some attributes of technology leadership. Likewise public (versus private) schools have a structural advantage. This does not mean that small schools or private schools lack charismatic technology leaders in the traditional sense. Rather, the schools with lower technology leadership are those with fewer mechanisms, policies, or processes in place that make it possible for the organization as a whole to effectively adapt technology for its educational mission. While these data reveal a "digital technology leadership divide," the gap is not as wide as what exists in some other areas such as home access to the Internet. Schools with more students below the poverty line tend to have less technology leadership.

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FIGURE 4: TECHNOLOGY LEADERSHIP INDEX (N=866)

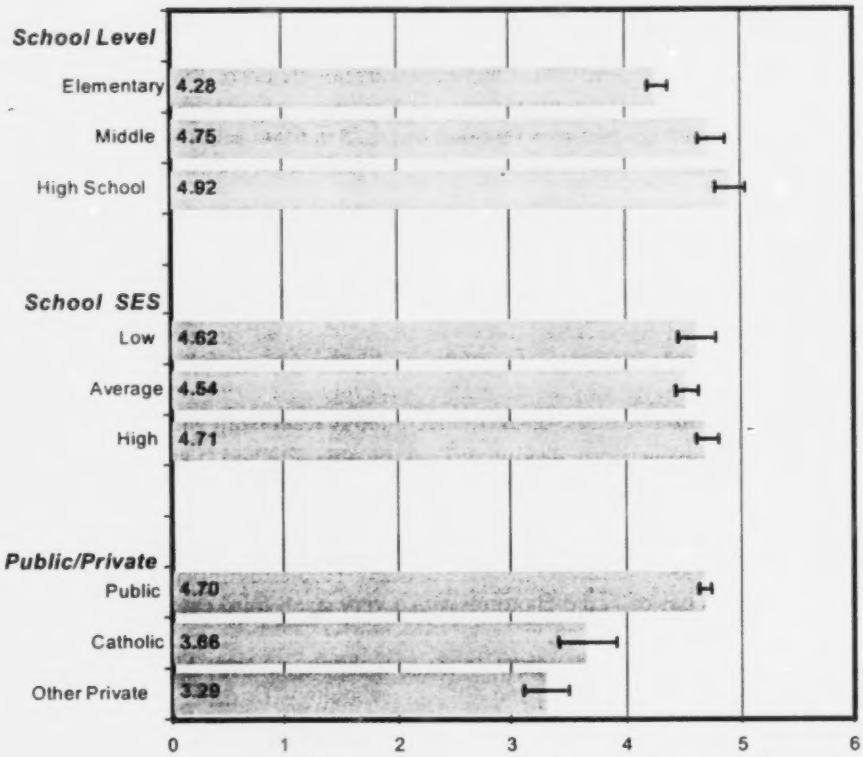

FIGURE 5(A): PERCENT OF PRINCIPALS DEVOTING 5+ DAYS TO TECHNOLOGY (N=749)

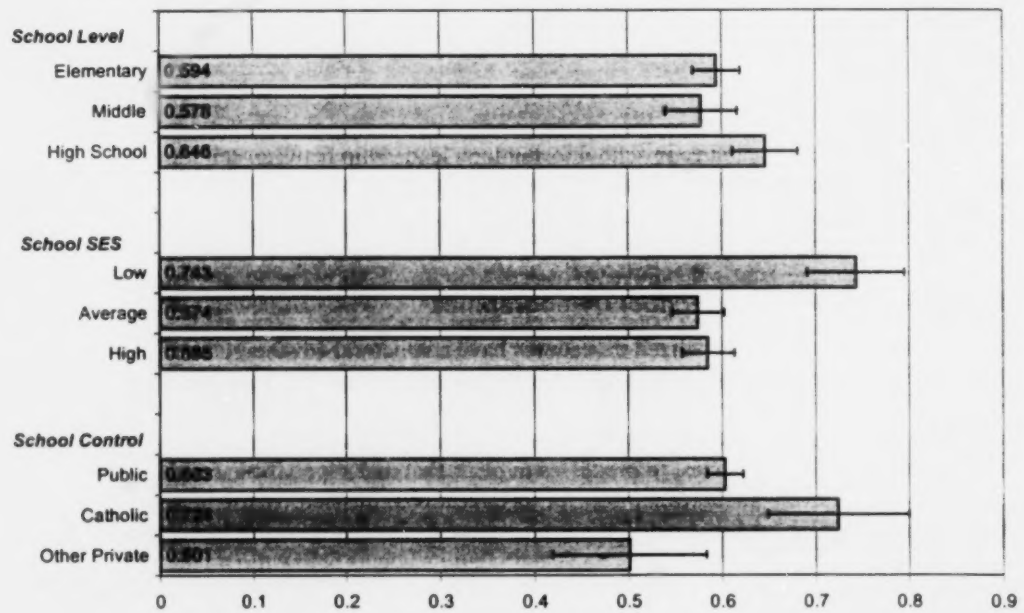

FIGURE 5(B): PERCENT WITH DISTRICT SUPPORTIVE OF TECHNOLOGY COSTS (N=848)

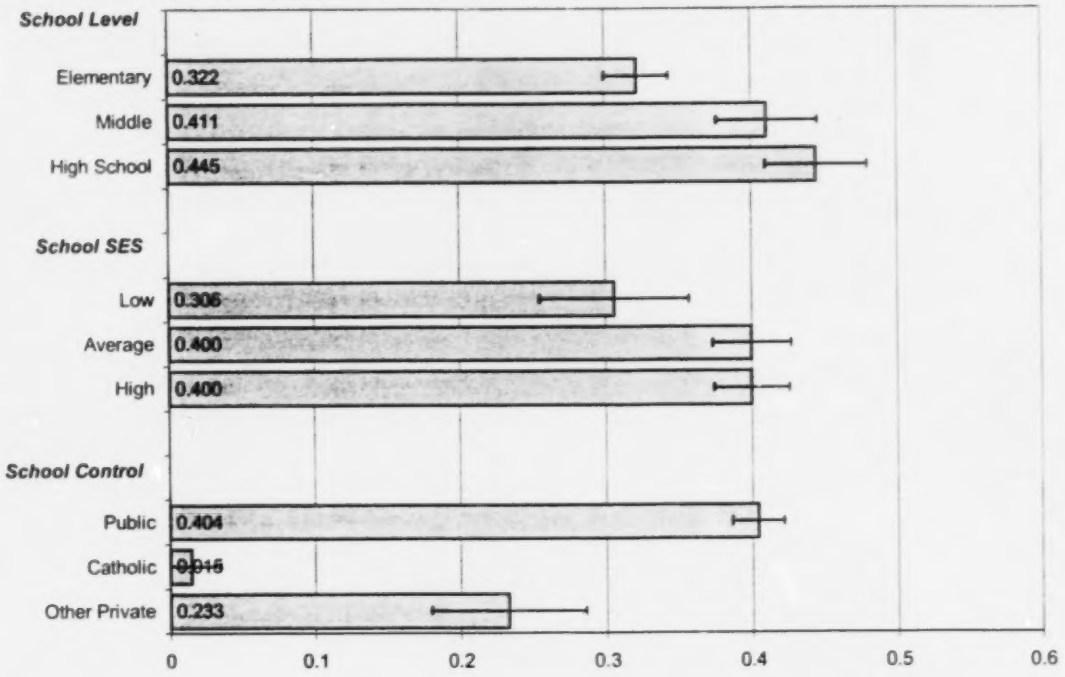

FIGURE 5(C): PERCENT WITH GRANTS FOR TECHNOLOGY (N=835)

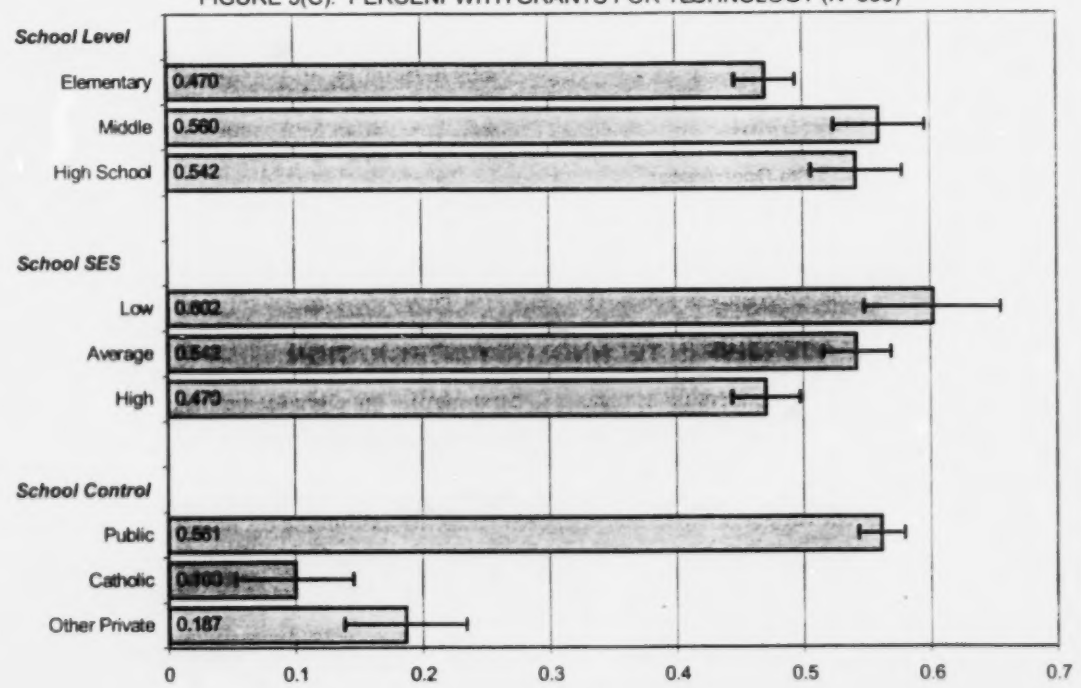

TABLE 2: LEADERSHIP MEANS ACROSS CATEGORIES OF DEMOGRAPHIC VARIABLES

	Mean	SD	N
School Level			
Elementary	4.28	1.85	459
Middle	4.75	1.71	201
High School	4.92	1.67	206
School SES			
Low	4.62	1.52	85
Average	4.54	1.75	345
High	4.71	1.88	355
Minority %			
0-1%	3.98	1.87	164
2-8%	4.64	1.78	177
8.5-38%	4.84	1.71	225
39-99%	4.49	1.78	250
Title-I %			
0-10%	4.92	1.62	197
11-22%	4.79	1.77	201
23-40%	4.65	1.85	189
41-100%	4.41	1.78	169
Public Private			
Public	4.70	1.76	755
Catholic	3.66	1.69	43
Other Private	3.29	1.62	67
Internet Type			
None	3.06	2.10	39
Modem	3.71	1.67	188
ISDN/56K	4.84	1.60	169
T1+	5.24	1.61	242
School Size			
Large	5.01	1.59	214
Average	4.32	1.87	483
Small	4.59	1.71	168
Sex of Principal			
Male	4.65	1.85	498
Female	4.39	1.71	368
Sex of Tech Coordinator			
Male	4.57	1.81	266
Female	4.50	1.77	430

THE ROLE OF LEADERSHIP IN TECHNOLOGY INTEGRATION

Overall school technology leadership as measured by summing the eight technology leadership attributes was stronger than infrastructure indicators in predicting technology pervasiveness in schools as measured by (1) integration of technology in teaching, (2) network and Internet utilization, and (3) student use of application tools. Table 3 shows the correlation matrix of each of the three dependent variables and the independent variables used in the each of the regression models. Technology leadership has a significant and positive correlation with each of the dependent variables.

TABLE 3: CORRELATION MATRIX OF VARIABLES FOR MULTIPLE REGRESSION

	1	2	3	4	5	6	7	8
1. Net Use (Y1)	1							
2. Integration of Technology (Y2)	0.530	1						
3. Student Tool-Use (Y3)	0.380	0.454	1					
4. Overall Technology Leadership	0.449	0.320	0.199	1				
5. Student/Computer Ratio	-0.241	-0.245	-0.161	-0.229	1			
6. T1 Access	0.380	0.171	0.148	0.298	-0.143	1		
7. Per Student Hardware Expenditures	0.152	0.133	0.060	0.130	-0.190	0.200	1	
8. Per Student Software Expenditures	0.208	0.163	0.097	0.178	-0.218	0.131	0.502	1

Tables 4, 5, and 6 display the results of the multiple regressions on each of the three dependent variables. The models not only regress leadership on each technology outcome variable, but also regress four additional infrastructure variables: (1) student/computer ratio, the standard measure of computer density, (2) whether or not the school had T1 (high-speed) Internet access, (3) the school's hardware expenditures during the previous two years, and (4) the school's software expenditures during the previous two years.

Only two variables, overall technology leadership and student/computer ratio were statistically significant predictors across all three outcome variables. And leadership was the strongest predictor for all three. T1 Internet access and software expenditures were significant predictors but only for the outcome variable 'net use.' These results generally support the main part of the path model depicted in Figure 2.

TABLE 4: REGRESSION RESULTS FOR DEMOGRAPHIC VARIABLES ON NET USE (Y_1)

	Net Use (Y_1)			
	b	se	Beta	p-value
Constant	8.942	0.318		0.000
Overall Technology Leadership	0.429	0.058	0.332	0.000
Student/Computer Ratio	-0.047	0.019	-0.109	0.013
T1 Access	1.215	0.212	0.255	0.000
Hardware Expenditures	0.000	0.000	-0.012	0.807
Software Expenditures	0.006	0.003	0.097	0.047
	R^2=0.29, Adjusted R^2=0.28			

TABLE 5: REGRESSION RESULTS FOR DEMOGRAPHIC VARIABLES ON TECHNOLOGY INTEGRATED TEACHING (Y_2)

	Integration of Technology (Y_2)			
	b	se	Beta	p-value
Constant	16.402	0.773		0.000
Overall Technology Leadership	0.717	0.141	0.251	0.000
Student/Computer Ratio	-0.152	0.046	-0.161	0.000
T1 Access	0.633	0.515	0.06	0.22
Hardware Expenditures	0.000	0.001	0.026	0.624
Software Expenditures	0.009	0.007	0.063	0.244
	R^2=0.14, Adjusted R^2=0.13			

TABLE 6: REGRESSION RESULTS FOR DEMOGRAPHIC VARIABLES ON STUDENT TOOL-USE (Y_3)

	Student Tool-Use (Y_3)			
	b	se	Beta	p-value
Constant	11.785	0.607		0.000
Overall Technology Leadership	0.303	0.11	0.141	0.006
Student/Computer Ratio	-0.078	0.036	-0.11	0.03
T1 Access	0.701	0.404	0.088	0.083
Hardware Expenditures	0.000	0.001	-0.020	0.725
Software Expenditures	0.005	0.006	0.046	0.411
	R^2=0.06, Adjusted R^2=0.05			

Infrastructure is important but for it to become part of the school culture, school leadership is necessary. For technology to become an integral part of a school, it not only is necessary to help teachers use the technology but administrators must be involved in it too. The importance of training for developing teachers in technology has long been recognized in the educational community. These findings indicate that administrative leadership and decision-making are equal, if not more important than spending on infrastructure to maintaining a successful technology program.

IMPLICATIONS

In this report the concept of school technology leadership is linked to decision-making about technology goals, policies, budgets, committees and other structural supports for improving technology's role in learning. More traditional leadership qualities such as charisma and dedication undoubtedly make a difference, but only if a supportive organizational system has been established.

The findings reported here reveal considerable diversity in technology leadership and organizational support systems. Even though the measure of technology leadership used in this analysis is limited and does not represent all of the areas of leadership and technology decision making, the results show that leadership has great impact on the outcomes or success of technology programs.

Administrators should consider a school technology audit to determine to what degree the school has adequate goals, policies, budgets, committees and other leadership processes in place to continue its evolution as a technology-supported learning organization. Because technology implementation requires policy, budget and finance, and various other organizational mechanisms, technology programs are doomed unless key administrators, as well as teachers, play active roles in these programs. Charismatic people may contribute to technology integration as well, but it is even more essential for a school to distribute leadership and become a "technology learning organization," where administrators, teachers, students, and parents together work on how best to adapt new technologies to improve learning.

REFERENCES

Bailey, G. D. (1997). What technology leaders need to know: The essential top 10 concepts for technology integration in the 21st century. *Learning and Leading with Technology*, 25, 1 (September), 57-62.

Becker, H. J. (1993). Decision making about computer acquisition and use in American schools. *Computer Education*, 20, 341-352.

Costello, R. W. (1997). The leadership role in making the technology connection. *T.H.E. Journal*, 25, 58-62.

Cradler, J. (2000). Implementing technology in education: Recent findings from research and evaluation studies. Far West Laboratory For Educational Research and Development [Online] Available: http://www.fwl.org/techpolicy/recapproach.html).

Czarnomski, K. F. and Granitz P. H. (1996). Designing Classrooms of Tomorrow. *American School & University*, 68, 78-80.

Dexter, S. L. (1999). The importance of leadership when implementing technologically focused innovations: Systemic reform or Cargo Cult? Paper presented by 1999 Annual Meeting of the American Educational Research Association, Montreal, Canada.

Fullan, M. and Stiegelbauer, S. (1991). *The New Meaning of Educational Change*. New York: Teachers College Press.

Jewell, Mary Jean (1998/1999). The art and craft of technology leadership. *Learning and Leading with Technology*, 26, 4, (December/January), 46-47.

Kearsley, G. & Lynch, W. (1992). Educational Leadership in the age of technology: The new skills. *Journal of Research on Computing in Educ*ucation, 25 (1) (Fall), 50-60.

Kowch, E. & Walker, K. (1996). Toulmin's moral reasoning model applied to ethical Internet choices: A means for exercising ethical technology leadership. *Canadian Journal of Educational Communication*, 25, (3) 235-254.

Law, .N. and Associates (1999). *SITES – Hong Kong SAR Report*. Hong Kong: Centre for IT School and Teacher Education, University of Hong Kong.

Louis, K. S. (1994). Beyond managed change: Rethinking how schools impress. *School Effectiveness and School Improvement*, 5, 2-24.

Mehlinger, H. D. (1996). School reform in the Information Age. *Phi Delta Kappan*. 77, 400-407.

Murphy, D. T. and Gunter, G. A. (1997). Technology integration: The importance of administrative support. *Educational Media International*, 34 (September), 136-139.

Musco, R. S. (1995). Selling a school technology budget. *Educational Leadership*, 53, 68-70.

Pelavin Research Institute (1997). *Investing in School Technology: Strategies to Meet the Funding Challenge.* Report prepared for the U.S. Department of Education. [Online] Available: http:// www.ed.gov/pubs/techinvest.

Ritchie, D. (1996). The Administrative Role in the Integration of Technology. *NASSP Bulletin,* 80, 42-52.

Neuman, M. and Simmons, W. (2000). Leadership for student learning. *Phi Delta Kappan,* 82 (1) (September), 9-12.

Ronnkvist, A. M., Dexter, S. L., and Anderson, R. E. (2000). Technology support: Its depth, breadth and impact in America's schools. (Teaching, Learning and Computing: 1998 National Survey, Report No. 5). Irvine, CA: Center for Research on Information Technologies and Organizations.

Schultz, L. E. (2000). Qualities of an exceptional leader. *Human Systems Management,* 19, 93-103.

Senge, P. (1998). *The Fifth Discipline.* New York: Doubleday.

Strudler, Neal (1995-96). The role of school-based technology coordinators as change agents in elementary school programs: A follow-up study. *Journal of Research on Computing in Education,* 28 (2), 234-257.

Thomas, L. G. & Knezek, D. (1991). Providing technology leadership for restructured schools. *Journal of Research on Computing in Education,* 24 (Winter), 265-279.

VanSciver, J. H. (1994). Using a strategic plan to promote technology in rural school districts. *NASSP Bulletin,* 78, 21-23.

APPENDIX: INDICATOR DESCRIPTIONS

DISTRICT SUPPORT *(District Supports Costs of Technology More Than Other Districts)*

"District Support" indicates how much a principal feels their district or diocese supports costs of technology relative to other districts or dioceses. Responses are coded '1' = school district supports technology more than other districts. '0' = district supports costs of technology the same or less than other districts.

ENROLL *(Enrollment of School)*

"Enroll" identifies the relative size of the school's enrollment (i.e. large, average or small). This was calculated by using the number of students enrolled at the school from the principal questionnaire (if missing, number of students from QED database was used) and taking into account school level. "Small," "average," or "large" differs depending upon the level. A value of '1' indicates a large school, '2' is an average school and '3' = small school. The intervals defined as small, medium and large were set so that about one fourth of the schools fell into 'small' category, one half into 'medium' category and the top fourth into the 'large' category. The cutting points were defined separately for elementary, middle and high schools, so as to avoid contaminating the school size variable with the school level variable. The result was the following breakdowns. For elementary schools, large schools had more than 600 students, average had 300-600 students and small had less than 300 students. For middle schools, large schools had more than 900 students, average had 300 to 900 students and small had less than 300 students. Finally, for high schools, large schools had more than 1500 students, average had 500 to 1500 students and small had less than 500 students.

GRANTS *(Grant Money for Computing)*

This variable indicates that the school or district obtained special grant(s) in the past 3 years for experimental programs where at least 5% of funding was dedicated to computer-related expenses. A value of '1' indicates that at least 5% of grant funding went to computing, '0' indicates less than 5% of grant money went for computing or that the school did not receive grant money for experimental programs.

INTEGRATION OF TECHNOLOGY *(Technology Integrated Teaching Practices)*

"Tech Integrated" indicates the fraction of teachers who are integrating technology into their various professional responsibilities, as reported by the technology coordinator. Technology coordinators were asked what proportion of the teachers in their schools did the following: experiment with new teaching methods involving computers, use computers for their own professional tasks, sometimes have students use computers to do curricular assignments, involved in planning or implementing Internet-based activities, and see technology coordinators for advice about integrating technology and curriculum. The following scale was used to estimate the proportions '1'=none, '2'=almost none, '3'=about 1/4, '4'=about half, '5'=about 3/4, '6'=almost all and '7'=all. Technology integrated teaching is the sum of scores across these activities.

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INTELLECTUAL PROPERTY POLICY *(School Has Policy on "'Honoring Intellectual Property Rights, e.g., copyrights")*

The intellectual property variable indicates that the school currently has a policy in place "honoring intellectual property rights, e.g. copyrights": '1' = yes, '0' = no.

INTERNET TYPE *(Bandwidth of Internet Access)*

This variable indicates the relative speed or bandwidth of the school's access to the Internet. It was based on a question in the technology coordinator questionnaire that asks respondents to identify how their school's computers or LANs are connected to the Internet. This variable was created by examining the type of connections to the Internet for instructional computers. Types of access are defined as follows, '0' = none or no Internet connection, '1' = modem, '2' = ISDN or 56K, '3' = T1 bandwidth or higher.

MINORITY% *(Percent Minority of Student Population)*

"Minority%" describes the percentage of minority students (i.e., non-white) in the schools. This was derived largely from the question "approximately, what percent of your students this year have an African-American, Latin-American, or American Indian heritage?" in the principal questionnaire. Respondents answered on a six-point scale with a don't know option. The categories were '1' = 0-1%, '2' = 2-5%, '3' = 6-10%, '4' = 11-25%, '5' = 26-50%, and '6' = 50% or more.

One issue was how to capture and include the percentage of Asian students. An estimate of the percentage of Asian students was available in the QED database. The mean of each of the percentage ranges from the principal questionnaire was added to the percentage of Asian students to get the total minority percentage. When respondents answered don't know or left this question blank, the minority percentage was calculated by adding percentages of four minority groups from the QED database (Black, Hispanic, Asian and Native American). The minority population variable used in the analysis groups the 'minority' variable into four nearly equal categories where '1' = 0-1%, '2' = 2-8%, '3' = 8.5-38% and '4' = 39% or more.

NET USE *(Extent of Teachers' Use of E-mail and Web for Various Purposes)*

"Net Use" is a measure of the extent to which teachers and others in the school used e-mail and the Web for a variety of purposes. The variable is the sum of frequency of teacher and student e-mail and web use, not just the type of a school's networking facilities. To create the variable, four questions were dichotomized such that responses of one-half or more are coded '2' and less than one half are coded '1'. The questions include: How many teachers have personal Internet accessible e-mail through school or privately? How many teachers are using e-mail regularly-say weekly? How many teachers have used the world wide web in their teaching? How many students have been involved in direct use of the web at school?

These questions were summed with four additional dichotomous ('2' = yes, '1' = no) questions about whether or not the school's networking facilities and connectivity have been used in programs such as: school-to-work transition programs, class or individual projects where the Internet is used to acquire information from community or other groups, communications to parents about the school program, homework assignments via web

pages or e-mail, students accessing information on school servers from home. NET USE is the sum of all 8 responses and ranges from '6' to '16'.

OVERALL TECHNOLOGY LEADERSHIP *(Presence of Leadership Characteristics)*

"Technology Leadership" is a variable that measures school technology leadership. It represents the organizational decisions, policies or actions that facilitate effective utilization of information technology throughout the school. The technology leadership variable is the sum of eight indicators: budget, district support for technology, grants, intellectual property policy, principal days devoted to technology, principal use of e-mail, staff development policy, and technology committee. Each of these variables is dichotomous, coded '1' and '0', and described in further detail in this appendix.

PER STUDENT HARDWARE EXPENDITURES *(Per Student Expenditures for Hardware during the Previous 2 Years)*

Per student hardware expenditures covers the previous two years and is calculated by dividing the total hardware expenditures during the 2 year period by the total number of students in the school.

SOFTWARE$ *(Per Student Expenditures for Software During the Previous 2 Years)*

Per student software expenditures covers the previous two years and is calculated by dividing the total software expenditures during the 2 year period by the total number of students in the school.

PRINCIPAL TECH DAYS *(Principal Time Spent on "Technology Planning, Maintenance, or Administration")*

Principal days on technology indicates that principals spent 5 or more days on technology planning, maintenance or administration during the past year. The variable is coded '1' if the principal spent at least 5 days on such activity, '0' if the principal spent fewer than 5 days on technology activity.

PRINCIPAL E-MAIL *(Extent of Principal Use of E-Mail)*

Principal e-mail use is constructed from principal responses to questions about any regular use of e-mail to communicate with: teachers, administrative staff, students, and parents. The variable is dichotomized so that '1' indicates principals who regularly e-mail with more than one of the groups, '0' indicates principals who regularly e-mail with no groups or only one group.

PUBLIC/PRIVATE

Public/Private collapses the school control (see below) categories into a dichotomous variable where '1' = Public schools and '2' = Private schools including catholic, other parochial and non-sectarian private schools.

SCHOOL LEVEL *(Grade Level of School)*

School level represents the level of the school where '1' is elementary schools, '2' is middle and '3' is high schools. This variable was created by examining the median grade of the school. Initially, school grade levels were from the sampling database that was constructed from the QED

database. This information was updated with responses provided by the school principal. Elementary schools were those schools with median grade ranges of 5.5 or below; middle schools have median grade ranges of 5.6-9.4; and high schools are those having median grade ranges of 9.5 or above.

SCHOOL SES *(Income Level of Households in Schools' Zip code)*

The Socioeconomic Status of the school was obtained using QED data based on the income level of households within the school's zip code. The original variable was based on a five-point scale where '0' = not classified, '1' = low SES, '2' = low to average SES, '3' = average SES, '4' = average to high SES and '5' = high SES. These categories were then collapsed into a trichotomous variable where '1' indicates low SES, '2' indicates average SES, and '3' indicates high SES.

SC-RATIO *(Number of Students Per Computer)*

Students-to-computer ratio is the number of students per computer. This variable was calculated by dividing the student enrollment by the total number of computers used for instruction. It is missing if either the numerator or denominator is zero or missing.

STAFF DEVELOPMENT POLICY *(School has Policy of "Periodic Staff Development Regarding Technology")*

The staff development variable indicates that the school currently has a policy in place for "periodic staff (teacher) development regarding technology": '1' = yes, '0' = no.

T1 *(School has Access to the Internet with a T1 Line)*

T1 indicates whether or not the school had a high-speed Internet access, that is, a bandwidth higher than 56K or an ISDN line. It was coded '1' if they did, and '0' otherwise.

BUDGET

"Budget" indicates if a school has a budget for technology costs over which the principal (or somebody else in the school) has sole discretionary authority. A value of '1' indicates the school had a such a budget, '0' indicates that an agent of the school did not have sole discretionary authority over such a budget.

TITLE1% *(Title 1 Eligibility)*

Title1% is the percent of students who qualify for Title-I programs. The data comes from the QED database and is grouped into four categories where '0' = 0-10%, '1' = 11-22%, '2' = 23-40% and '3' = 41-100%.

TOOLUSE *(Students' Use of Computers for Academic Work)*

"Tooluse" measures the extent to which students use computers during the school year to do academic work including writing reports, essays, etc.; simulations in science and social studies, spreadsheets, and databases; looking up information on CD-ROMS, the WWW and other computer resources. Technology coordinators were asked roughly what percentage of student use of computers would involve each of the above categories of activity, where responses were coded '1' = 0%, '2' = 5%, '3' = 10%, '4' = 15%, '5' = 25%, '6' = 40%+. "Tooluse" is the sum of responses to the three questions.

END

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